I.T. Uptake in the Australian Construction Industry

Results of a national survey into the uptake and implementation of information and communication technology (ICT) in the Australian construction industry

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Foreword

The Cooperative Research Centre (CRC) for *Construction Innovation* is committed to leading the Australian property, design, construction and facility management industry in collaboration and innovation. We are dedicated to disseminating the practical research outcomes to our industry – to improve business practice and enhance the competitiveness of your firm. Developing applied technology and management solutions, and delivering education and relevant industry information is what our CRC is all about.

This publication "I.T. Uptake in the Australian Construction Industry" results from of one of our leading projects headed by Assoc Prof Stephen Kajewski (*QUT*), with a project team comprising Mr. Graham Brewer *(University of Newcastle),* Mr G Caldwell and Mr John Spathonis *(Qld Dept of Main Roads),* Prof Swee-Eng Chen, Dr Rod Gameson, Mr. Richard Kolomy, Professor Dennis Lenard, Mr Rui Martins and Mr. Willy Sher *(University of Newcastle,* Mr. John Crawford *(CSIRO),* Mr. Mark Haug *(Qld Dept of Public Works),* Ms Melissa James *(?),* Mrs Debbie Smit and Mr Achim Weippert *(Queensland University of Technology)* and Mr. Paul Tilley and Dr Selwyn Tucker *(CSIRO)*.

This Publication has examined……and provides clear guidelines to industry in the area of….to improve the business.

We look forward to your converting the results of this CRC research project into tangible outcomes and working together in leading the transformation of our industry to a new era of enhanced business practices, safety and innovation within the sector.

Mr John McCarthy
Chair

Dr Keith Hampson
Chief Executive Officer

Contents

1. Background

A national survey was carried out within the construction industry — including non-building, building (commercial/industrial), and residential sub-sectors — to inform decision makers on ICT policy relating to the:

- types of ICT being used across the construction industry sub-sectors and for various project sizes to enable the decision makers to identify possible improvements through ICT uptake
- preferred mode of training amongst construction industry employees allowing the decision makers to implement suitable ICT training regimes for employees
- benefits/drivers and barriers/limitations to the uptake of ICT on construction projects to enable the decision makers to identify suitable ICT implementation strategies within their organisations.

The investigation targeted three broad areas:

- **Current ICT status,** including annual ICT investment, access to and use of ICT devices according to annual turnover
- **ICT training,** including training participation by individuals, training support in respondent organisations in connection with workload and time flexibility for employees, preferred mode of training for individuals, and the level of ICT competence expectations that various construction project participants have of their colleagues
- **ICT trends and opinions** on the benefits/drivers and barriers/limitations to implementing and using ICT on construction projects.

2. Survey Population

The population for the survey was defined as members of the Australian construction industry in 2003. The sample frame, however, was limited to those known to have an IT capacity. It was believed that the sample frame would be representative of the general population. In all, 467 potential respondents were emailed and informed how they were chosen for the survey, the organisation carrying out the survey, and the research objectives. Data collection was completed by 14 November 2003.

3. Respondents' Profiles

Respondents were asked to answer questions to enable detailed comparative analysis of the responses. In terms of a general profile, the analysis revealed that:

- 92% of respondents were from the East Coast of Australia
- 78% of respondents have some form of tertiary qualification
- 71% of respondents were in some form of managerial role within their organisation
- all respondents had more than one year's service, and 54% had at least 10 years' service in their present position
- sixty-one per cent were from a contracting organisation and 28% were from a consultant/specialist organisation, with the remaining 11% being spread between supplier and client organisations
- most respondents (74% of those who knew the organisation's annual turnover) had annual organisation turnovers of less than $5m, and 10% of respondent organisations had annual turnovers of $100m or greater
- at least 80% of respondents were from the building construction sub-sector.

4. Key Observations from the Survey Results

Effects of budget on uptake and current ICT status

- In general, higher ICT investment was observed for higher annual turnover organisations.
- In general, these organisations, made more use of emerging or innovative ICTs such as handheld and tablet computers, video conferencing and wi-fi devices.
- Budget was the most significant barrier/limitation to ICT on projects.

Effects of budget on ICT training

- Lower-turnover construction organisation respondents were less likely to have undergone ICT training.
- Lower-turnover construction organisations gave less support to ICT training through flexible workload and time allocation.
- Higher-turnover organisations generally preferred the professional consultants' mode of training and, conversely, lower-turnover organisations generally preferred self-learning.

Technical issues

For most respondents, problems with interoperability and not having an ICT professional on site or within ready access were found to be strong barriers to the uptake of ICT.

Driver for ICT uptake

The overriding reason for ICT uptake was to improve operational performance through improved productivity at both the personal and organisational/team levels. Improved business opportunity was also highly influential for respondents. Similar results to these were found on investigating results according to industry sub-sectors. Interestingly, the residential sub-sector rated improved business opportunities as a more important driver to uptake than did the other two sub-sector groups.

5. Current ICT Status

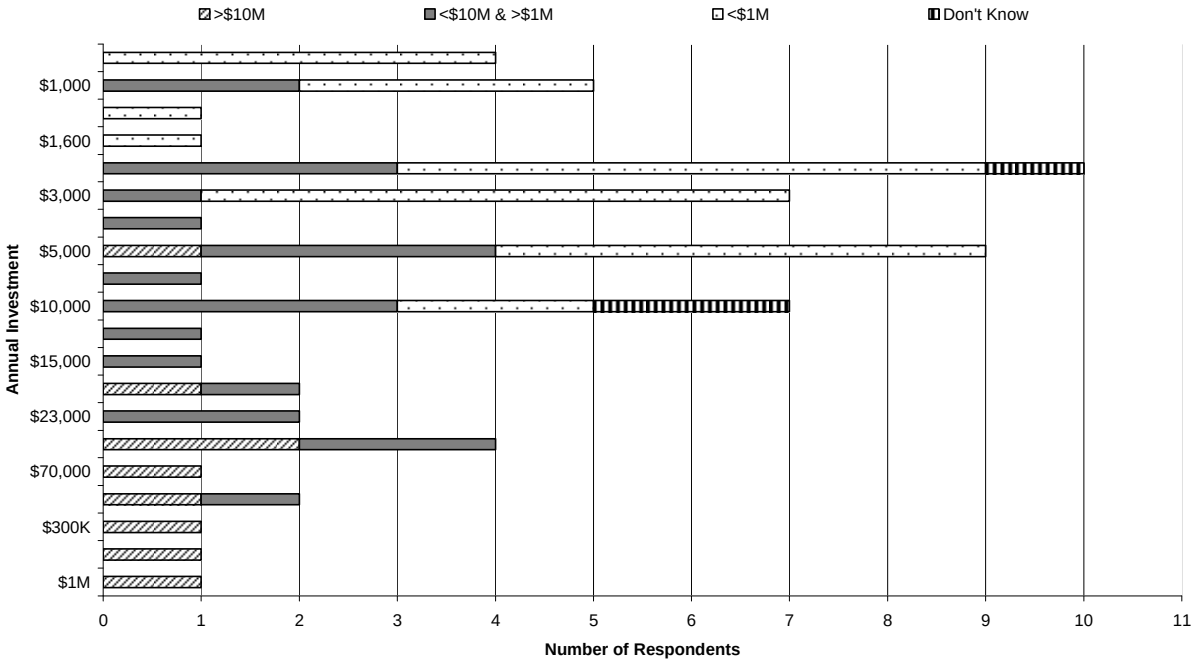
This section investigates the current ICT status of the survey respondents, and their organisations where appropriate, including:

- ICT organisational investment: including further analysis of ICT investment according to sub-sector and annual turnover
- ICT device access and use: including access and use for various devices, access and use of emerging/innovative technologies by annual turnover.

5.1 ICT organisational investment

The annual amount spent on ICT investment varied considerably from $500 to $1,000,000 with the most frequent amount specified being $2,000. The factors expected to be influential on ICT investment included annual turnover and the industry sector.

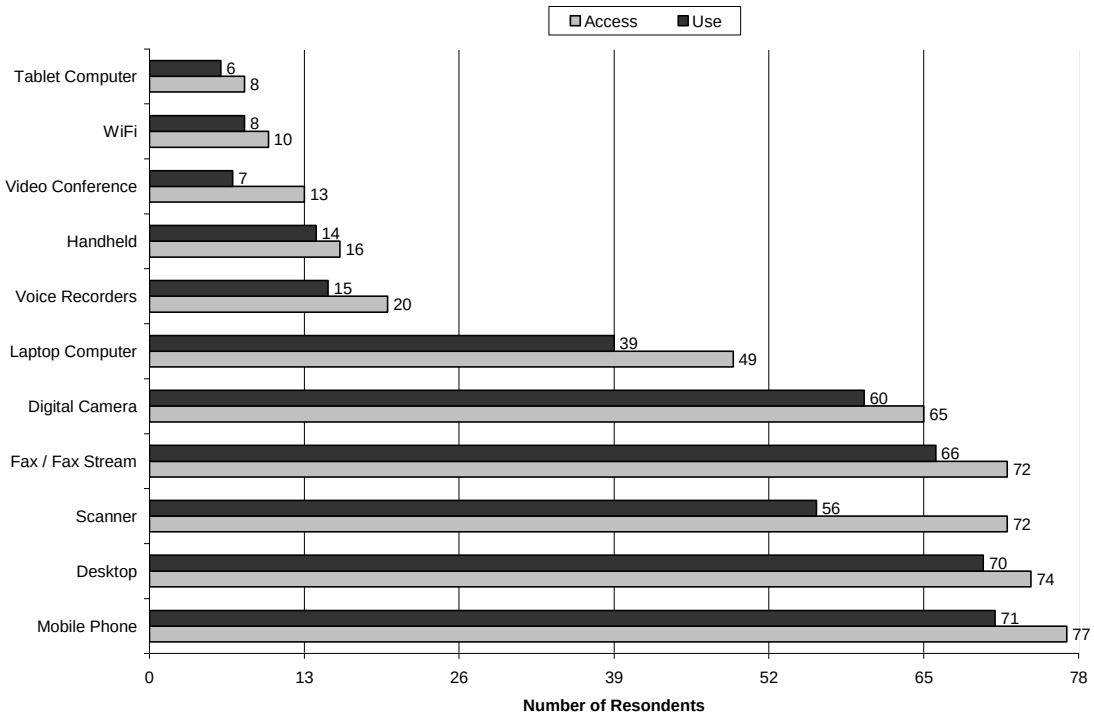
Table 1: Annual ICT Investment by Organisational Turnover



5.2 ICT device access and use

Respondents were asked to identify which ICT devices, from a specified range, they have access to within their company and, after this, they were asked which of these devices they used on a range of project sizes.

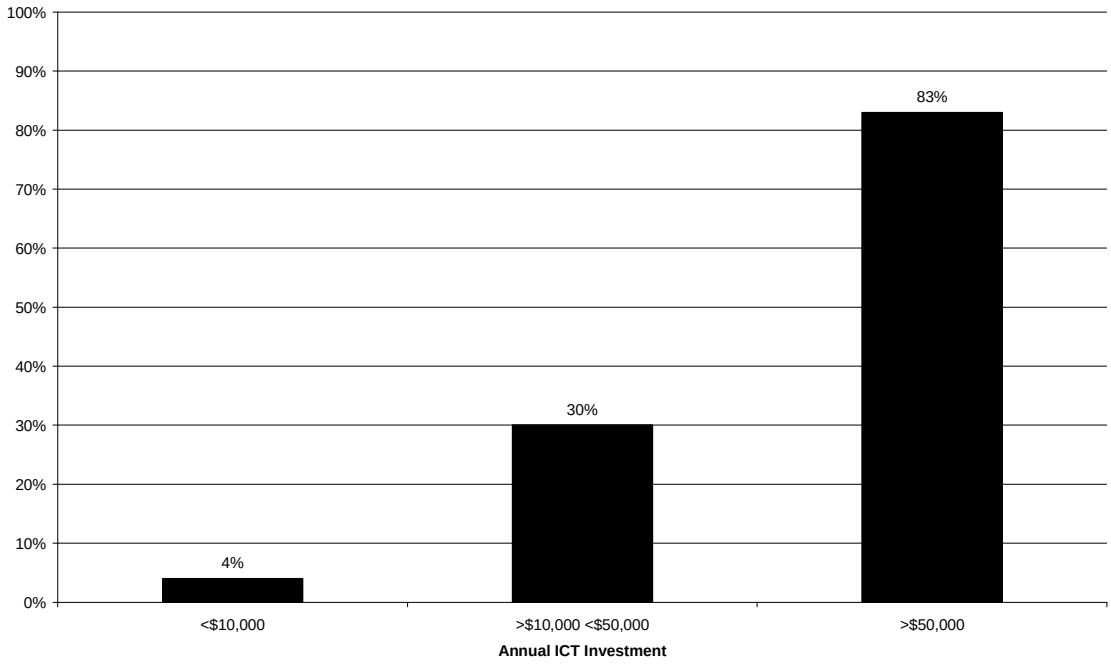
Table 2: ICT Device Access & Use



The list provides a range of ICT technologies. Some ICT technologies, such as desktop computer, mobile phone, scanner, fax and digital camera, are established technologies and, according to the responses, are accessible by most respondents. These technologies are widely used on construction projects.

When considering emerging technologies such as wi-fi, handheld and tablet computers, and video conference equipment, the analysis revealed that the more money the companies invested in ICT, the more ICT they accessed. This is illustrated in the following table which displays the distribution of access to handheld computers according to the ICT investment category. This chart shows that 83% of the respondents with an annual ICT investment budget greater than $50,000 have access to handheld computers, compared with only 4% of those with an ICT budget of less than $10,000. A similar pattern is revealed when analysing technology usage for other emerging technologies.

Table 3: Handheld Computer Access by ICT investment category



6. ICT Training

Also investigated were the ICT training characteristics of the respondents and respondent's organisations including:

- official ICT training participation — including overall participation, participation considering annual turnover, and participation variability in the sub-sector groups
- ICT training company support — including whether the respondents were allowed time or workload flexibility to undergo ICT training; sub-sector analysis was also completed
- ICT training mode preference — including an analysis of how annual turnover ranges influenced this
- ICT competence expectations — including respondent's expectations by sub-sector group.

6.1 ICT training participation

Respondents were asked to indicate whether they had undergone any official ICT training. Almost half (49%) of the respondents indicated that they had. When comparing responses by the company classification, sub-contractors were more likely to have never undergone official training. Larger ($100m+ turnover) organisations had a higher proportion of respondents indicating they had undergone official training.

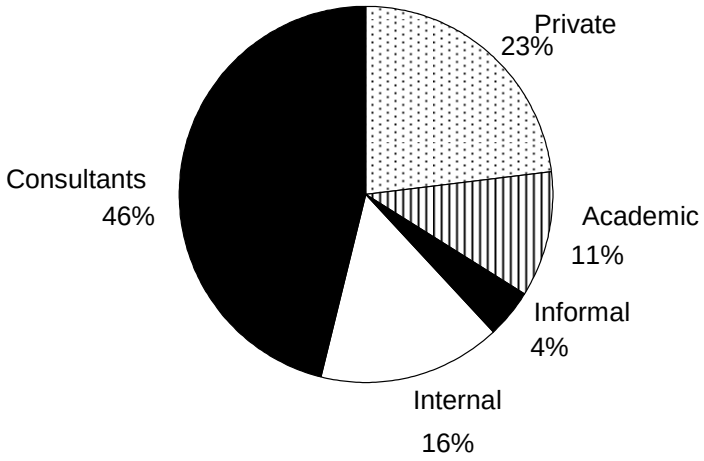
6.2 Company support for ICT training

Over half of the respondents indicated that their company did allow them sufficient time during office hours to undergo ICT training. Respondents were also asked whether their company adjusted or reduced their workload to undergo ICT training. Only 10 respondents indicated that their company did adjust or reduce their workload. Interestingly, six of those were from companies with a turnover between $1m and $5m.

6.3 ICT training mode preference

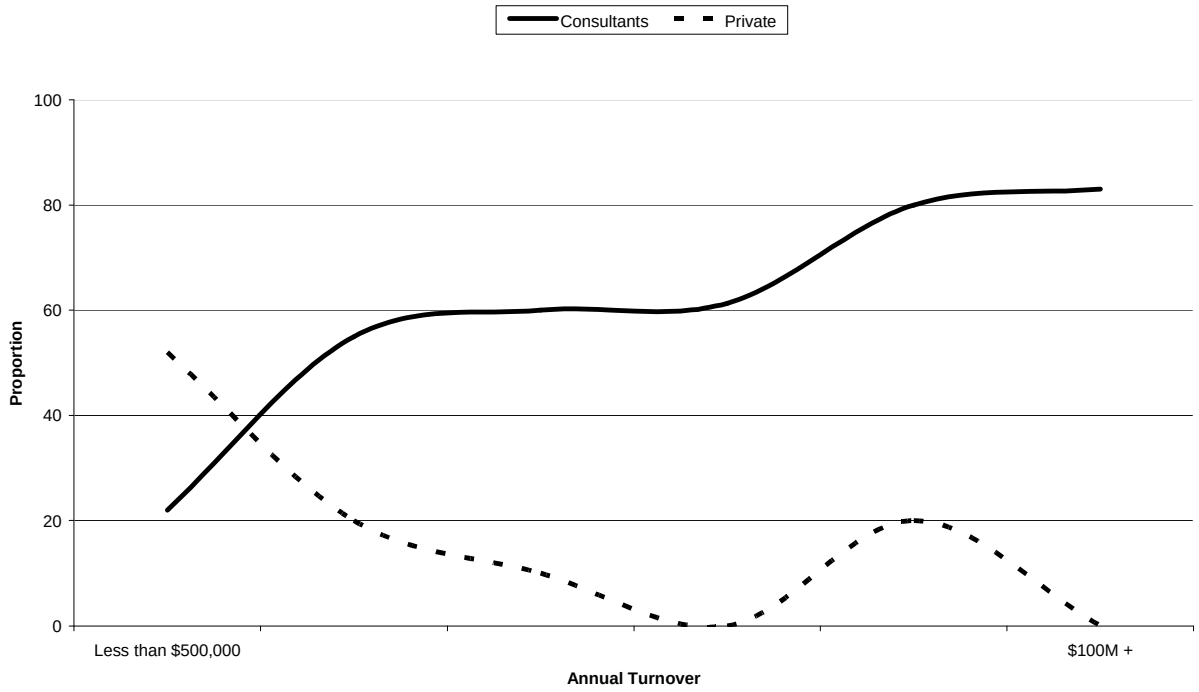
Respondents were asked to nominate their preferred mode of training from a selected list. Nearly half (46%) nominated professional consultants.

Table 4: Preferred Mode for ICT Training



The training mode preference trend indicated below shows the response trend dependent on the respondent's turnover classification. The chart shows an increasing preference for professional consultants as the annual turnover category increases. Eighty-six per cent of respondents from the higher-turnover categories indicated a preference for training with professional consultants compared with the lower-turnover categories, where 52% indicated a preference for private training.

Table 5: Training mode trend



7. ICT Trends and Opinions – Benefits, Barriers and Limitations

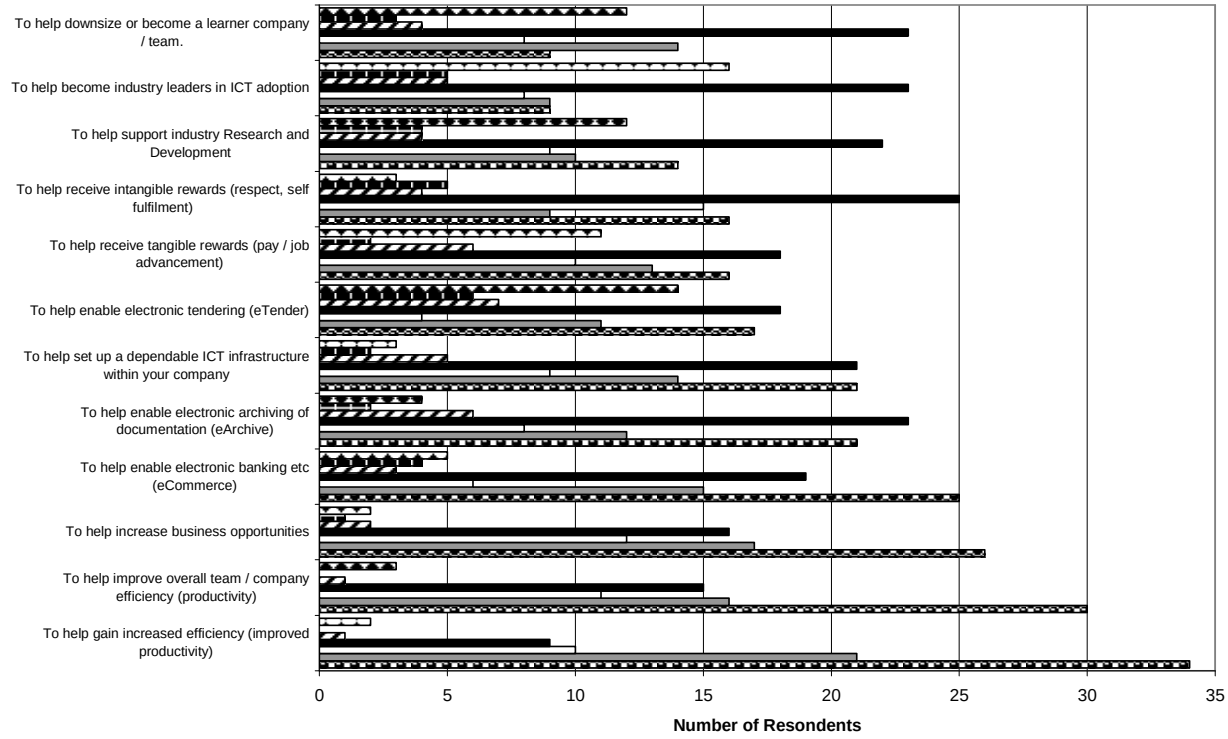
The investigation examined trends and opinions as to the benefits, barriers and limitations to the implementation or use of ICT on construction projects.

7.1 Benefits for ICT on projects

Respondents were asked to indicate what influence a specified range of benefits has on their decision to use ICT on projects.

The mean response rating for most "issues" was above average, and this suggested that most issues were influential in their decision to use ICT on projects. The only issue with a below-average mean response was "*To help become Industry leaders in ICT adoption*".

Table 6: Benefit/Driver Response Rate Distribution



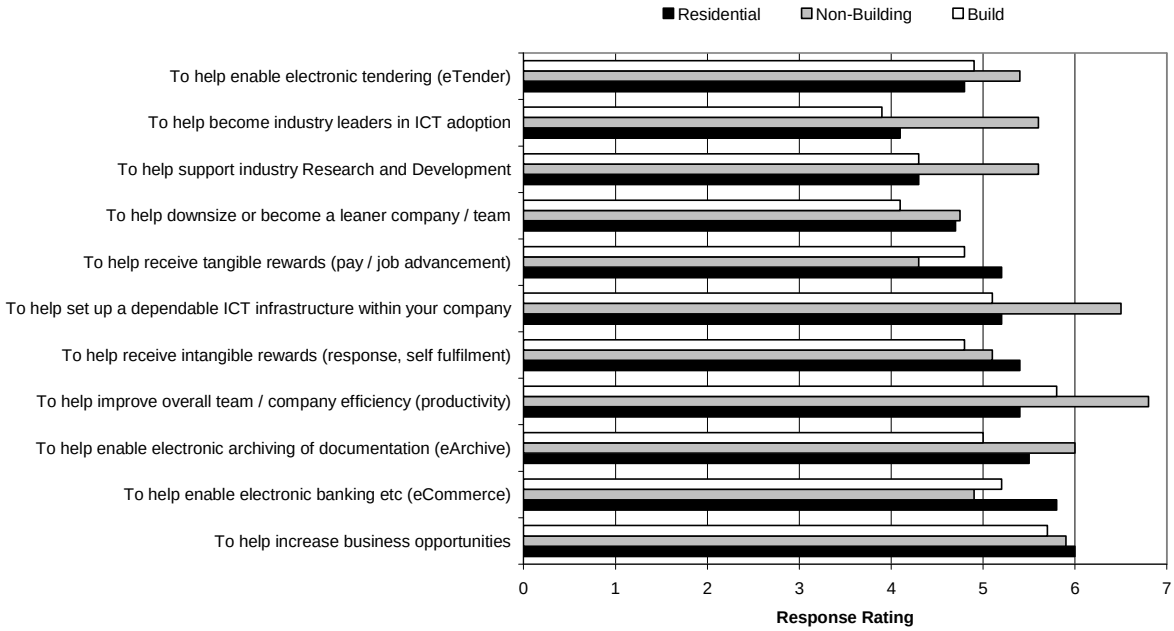
The table shows that the issue with the highest mean rating was "*To help gain increased efficiency (improved productivity*)" followed by "*To help improve overall team/company efficiency (productivity)*" and "*To help increase business opportunities*".

The issues found to be of least influence, in order of influence, include *"To help become industry leaders in ICT adoption"; "To help enable electronic tendering (e-Tender)";* and *"To help downsize or become a leaner company/team".*

Essentially, respondents perceive ICT to provide productivity benefits to their project operations, both at the individual and team/company level. They also perceive some strategic benefits in the way of improved business opportunities that the ICT may provide.

The next table shows the differences within various sub-sectors of the industry.

Table 7: Benefit/Driver for ICT Implementation or Use on Projects for Sub-Sector Groups



The non-building sub-sector respondents saw "*To help improve overall team/company efficiency (productivity)*" and "*To help gain increased efficiency (improved productivity)*" as the most influential benefit to ICT use on projects. Other issues, which have a strong influence for the non-building sub-sector respondents are, in order of influence, *"To help set up a dependable ICT infrastructure within your company"; "To help enable electronic archiving of documentation (e-Archive)";* and *"To help increase business opportunities".*

Note that the non-building sub-sector indicated that "*To help set up dependable ICT infrastructure"* was more influential than "*To help increase business opportunities*" whereas the overall mean response showed a different result.

Building construction (commercial/industrial) respondents perceived "*To help gain increased efficiency (improved productivity)"* and "*To help improve overall team/company efficiency (productivity)"* as the most influential benefits to using ICT on projects. Other issues, which have a strong influence for the building construction sub-sector are, in order of influence, *"To help increase business opportunities"; "To enable electronic banking etc. (eCommerce)";* and *"To help set up a dependable ICT infrastructure within your company".*

The residential sub-sector respondents considered "*To help gain increased efficiency (improved productivity)"* and *"To help increase business opportunities"* as the most influential benefits to ICT use on projects. Other issues, which have a strong influence for the residential sub-sector are, in order of influence, *"To enable electronic banking etc. (eCommerce)"; "To help enable electronic archiving of documentation (e-Archive)";* and *"To help receive intangible rewards (respect, self-fulfilment)".*

It is interesting to note that the residential sub-sector rated the increase in business opportunity benefit as more influential than the other sub-sectors did. Another interesting result for the residential sub-sector is the relatively high influence rating, compared to the group mean, for the issue "*To help receive tangible rewards (pay/job advancement)*". It is also interesting to note that the issue "*To help enable electronic tendering (e-Tender)*" had less influence on those in the residential construction sub-sector than the other two issues did.

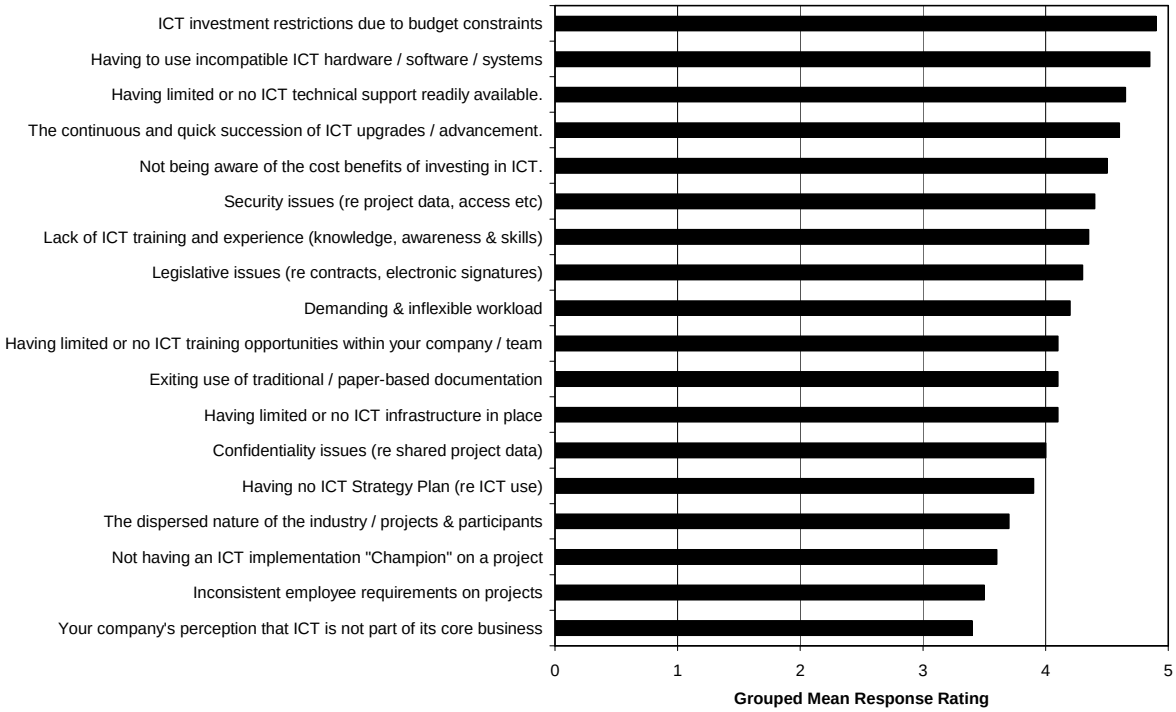
7.2 Barriers/limitations for ICT on projects

Respondents were asked to indicate what influence a specified range of barriers/limitations has on their decision to use ICT on projects.

Table 10 shows that all issues are grouped between slightly-below to slightly-above average influence and that "*ICT investment restrictions due to budget constraints*" was most influential. Technical issues such as "*Having to use incompatible ICT hardware/software/systems"*, "*Having limited or no ICT hardware/software support readily available"* and "The continuous and *quick succession of ICT upgrade/advancement"* were the next most influential barrier/limitations issues when deciding whether to use ICT on projects.

The issues found to be of least influence, in order of influence, include *"Your company's perception that ICT is not part of its core business"; "Inconsistent employee requirements on projects"; and "Not having an ICT implementation 'Champion' on a project".*

Table 8: Barrier/Limitation for ICT Implementation or Use on Projects - Group Mean



There were some interesting variations within sub-sectors as shown in Table 11.

Non-building construction respondents perceived *"Having limited or no ICT technical support readily available"* and "*Demanding and inflexible workload"* to be equally the greatest barriers/limitations influencing their decision to use ICT on projects. Other issues having a strong influence for this sub-sector were, in order of influence, *"Having limited or no ICT training opportunities within your company/team"; "Having to use incompatible ICT hardware/software/systems";* and *"Having limited or no ICT infrastructure in place".*

It is interesting to note that "*ICT investment restrictions due to budget constraints"* was not as highly influential for this sub-sector as for the other sub-sectors. This may be a result of the relationship between ICT investment and annual turnover, where results indicate that a large percentage (86%) of the non-building sub-sector respondent organisations were in the high annual turnover range (greater than $5m). It would appear that they typically have more money to invest, hence their lower perceived restriction on budgets for ICT, and that they have a general tendency to be more innovative. All the issues presented were perceived by

the non-building sub-sector to be at least an average influential barrier/limitation to ICT use on projects.

The relatively high influence of "*Having limited or no ICT training opportunities within your company/team*" is an interesting result because all respondents in this sub-sector indicated that they are allowed sufficient time during office hours to undergo official ICT training.

Building construction (commercial/industrial) respondents thought that "*ICT investment restrictions due to budget constraints*" and "*Having to use incompatible ICT hardware/software/systems"* were the most influential barriers/limitations to using ICT on projects. Other issues that have a strong influence for this sub-sector, in order of influence, were *"Having limited or no ICT technical support readily available"; "Existing use of traditional/paper-based documentation";* and *"The continuous and quick succession of ICT upgrades/advancement".*

The residential sub-sector respondents put "*The continuous and quick succession of ICT upgrades/advancement"* and *"ICT investment restrictions due to budget constraints"* as their most influential barriers/limitations to ICT use on projects. Other issues having a strong influence for this sub-sector were, in order of influence, *"Not being aware of the benefits of investing in ICT"; "Having to use incompatible ICT hardware/software/ systems";* and *"Demanding and inflexible workload".*

Table 9: Barrier/Limitation for ICT Implementation or Use on Projects for Sub-Sector Groups

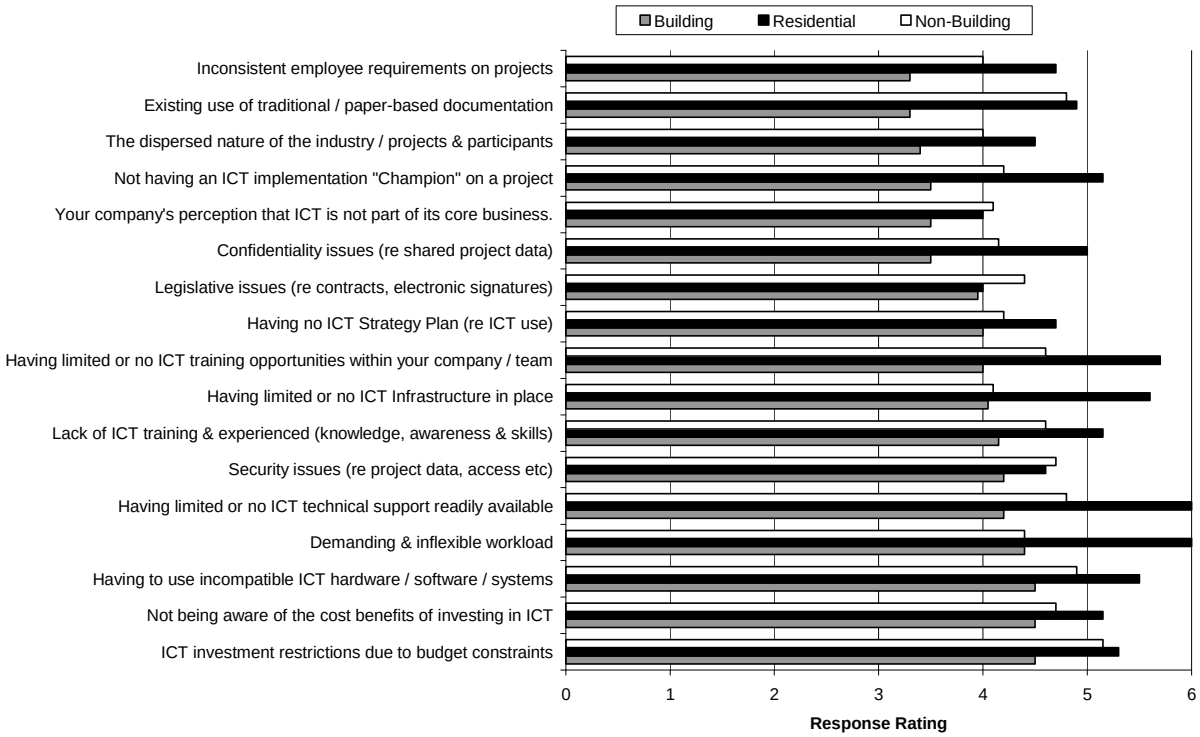
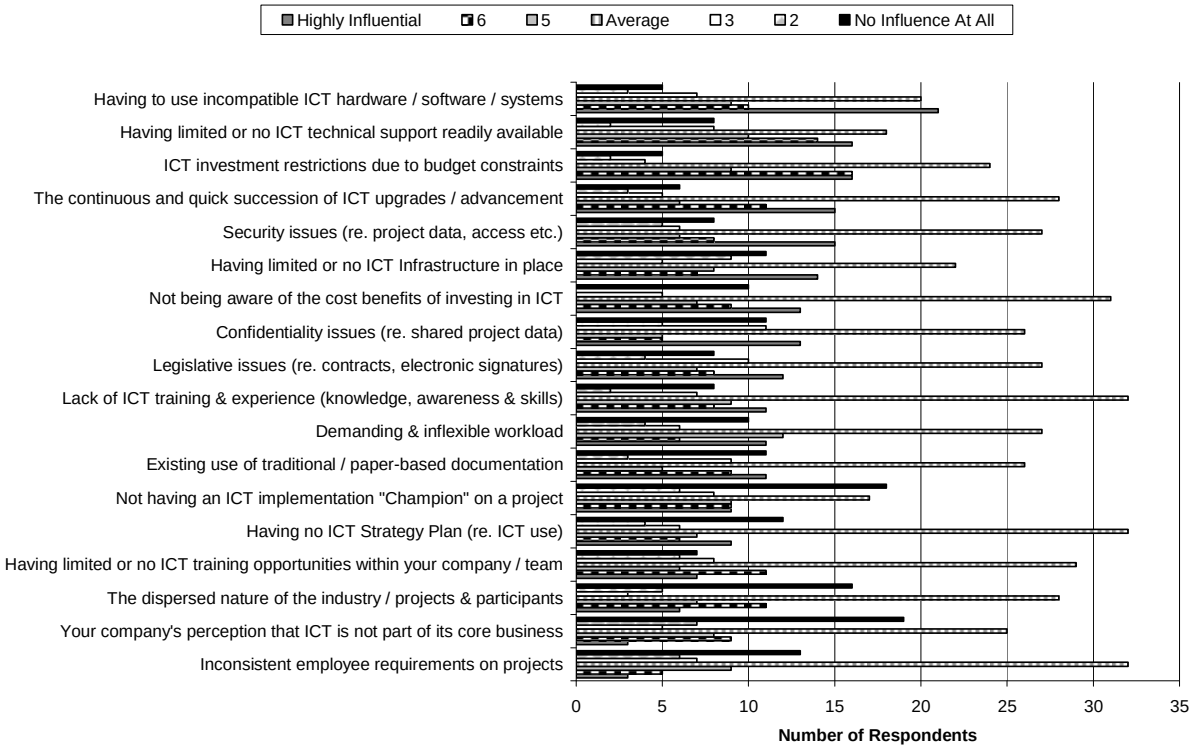


Table 10: Barrier/Limitation Response Rating Distribution



The following summary assists in gaining an appreciation of the most influential benefit/driver issues for respondents from the three sectors.

Group	Benefit/driver influence ranking				
	First	**Second**	**Third**	**Fourth**	**Fifth**
Total mean	*To help gain increased efficiency (improved productivity)*	*To help improve over all team/company efficiency (productivity)*	*To help increase business opportunities*	*To help enable electronic banking etc. (eCommerce)*	*To help set up a dependable ICT infrastructure within your company*
Non-building	*To help improve overall team/company efficiency (productivity)*	**To help gain increased efficiency (improved productivity);* and **To help set up a dependable ICT infrastructure within your company*		*To help enable electronic archiving of documentation (e-Archive)*	*To help increase business opportunities.*
Building	*To help gain increased efficiency (improved productivity)*	*To help improve overall team/company efficiency (productivity)*	*To help increase business opportunities*	*To help enable electronic banking etc. (eCommerce)*	*To help set up a dependable ICT infrastructure within your company*
Residential	*To help gain increased efficiency (improved productivity)*	*To help increase business opportunities*	*To enable electronic banking etc. (eCommerce)*	*To help enable electronic archiving of documentation (e-Archive)*	*To help receive intangible rewards (respect, self-fulfilment)*

** Both had same influence and tied for second.*

The following summary assists in gaining an appreciation of the most influential barrier/limitation issues for respondents from the three sectors.

Sub-sector	Barrier/limitation influence ranking				
	First	**Second**	**Third**	**Fourth**	**Fifth**
Total mean	*ICT investment restrictions due to budget constraints*	*Having to use incompatible ICT hardware/software/ systems*	*Having limited or no ICT technical support readily available*	*The continuous and quick succession of ICT upgrades/advanc ement*	*Not being aware of the cost benefits of investing in ICT*
Non-building	**Having limited or no ICT technical support readily available;* and **Demanding and inflexible workload*		*Having limited or no ICT training opportunities within your company/team*	*Having to use incompatible ICT hardware/softwar e/systems*	*Having limited or no ICT infrastructure in place*
Building	*ICT investment restrictions due to budget constraints*	*Having to use incompatible ICT hardware/software/ systems*	*Having limited or no ICT technical support readily available*	*Existing use of traditional/paper-based documentation*	*The continuous and quick succession of ICT upgrades/ advancement*
Residential	*The continuous and quick succession of ICT upgrades/advanc ement*	*ICT investment restrictions due to budget constraints*	*Not being aware of the cost benefits of investing in ICT*	*Having to use incompatible ICT hardware/softwar e/systems*	*Demanding and inflexible workload*

** Both had same influence and tied for first.*

8. Future surveys

Researchers recommend that the distribution and analyses of similar surveys are to be repeated periodically (e.g. every two years) so that changes, advances, shifts, etc. of ICT uptake within the Australian construction industry can be observed.

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Further information

Further detail on the recommendations and guidelines can be found in report 2001-008-C-08 "A National Perspective on the Status of ICT in the Australian Construction Industry" and 2001-008-C-09 "Recommendations and Guidelines: To help improve ICT integration within today's AEC industry" from the CRC Construction Innovation Project 2001-008-C "Project Team Integration: Communication, coordination and decision support"

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